

Claim amendments

Claim 1. (Currently amended) A sensor node comprising:

at least one processor;

at least one energy source;

a multiple-mode radio frequency modem operable in both a master mode and a slave mode, wherein the modem operates in the master mode when the sensor node has a number of connections to neighbor nodes of the sensor node that exceeds a respective number of connections that each of the neighbor nodes of the sensor node has to its own neighbor nodes by a threshold number of connections, wherein while the modem operates in the master mode, the sensor node is configured to control a frequency hopping pattern for each neighbor node of the sensor node, ~~a given node remote from the sensor node,~~ and wherein the modem operates in the slave mode when a neighbor node of the sensor node has a number of neighbor node connections that exceeds the number of connections to neighbor nodes of the sensor node by the threshold number of connections, and wherein while the modem operates in the slave mode, the sensor node is configured to acquire and follow a frequency hopping pattern of a neighbor node of the sensor node that operates as a master to the sensor node; ~~a remote node operating as a master;~~ and

at least one substrate coupled among the at least one processor, the at least one energy source, and the multiple-mode radio frequency modem,

wherein the at least one substrate comprises at least one sensor.

Claim 2. (Original) The sensor node of claim 1, wherein the at least one

substrate comprises active and passive substrates.

Claim 3. (Previously presented) The sensor node of claim 2,
wherein the at least one substrate comprises at least one thin film substrate,
wherein the at least one thin film substrate comprises a piezoelectric polymer film, and
wherein the piezoelectric polymer film is polyvinylidenedifluoride (PVF₂).

Claim 4. (Original) The sensor node of claim 1, wherein the at least one
substrate is conformal.

Claims 5-8. (Canceled)

Claim 9. (Original) The sensor node of claim 1, further comprising at
least one communication physical layer including radio frequency (RF) power management.

Claim 10. (Original) The sensor node of claim 1, wherein the at least one
processor is coupled to at least one component selected from a group consisting of
actuators, sensors, signal processors, interfaces, power supplies, data storage devices, and
communication devices.

Claim 11. (Previously presented) The sensor node of claim 1, wherein the at
least one sensor comprises at least one sensor selected from a group consisting of passive
sensors, active sensors, seismic sensors, acoustic sensors, optical sensors, infrared sensors,

magnetic sensors, thermal sensors, accelerometers, and bi-static sensors.

Claim 12. (Previously presented) The sensor node of claim 1, wherein the at least one energy source includes a thin film photovoltaic device, and wherein the thin film photovoltaic device comprises an energy source and an optical presence detection sensor.

Claim 13. (Original) The sensor node of claim 1, wherein the sensor node is coupled to at least one item selected from a group consisting of machinery components, electronic equipment, mechanical equipment, electro-mechanical equipment, a facility, a structure, a material, a biological system, people, animals, vegetation, clothing, crates, packages, product containers, shipping containers, a transportation system, vehicle components, an outdoor area, and an indoor area.

Claim 14. (Previously presented) The sensor node of claim 1, wherein the at least one sensor is operable to receive at least one signal type selected from a group consisting of temperature, shock, vibration, motion, acceleration, tip, light, sound, and package opening and closing.

Claim 15. (Canceled)

Claim 16. (Previously presented) The sensor node of claim 56, wherein the plurality of network elements comprises a sensor network including at

least one node,

wherein the at least one node is coupled among a monitored environment and at least one client computer,

wherein functions of the at least one node are remotely controllable using the at least one client computer,

wherein the at least one node is configured to provide node information including node resource cost and message priority to the plurality of network elements, and

wherein data processing is distributed through the sensor network in response to the node information.

Claim 17. (Canceled)

Claim 18. (Previously presented) The sensor node of claim 56,

wherein the plurality of network elements comprises a sensor network including at least one node and at least one client computer,

wherein the sensor node is coupled to the at least one client computer through the plurality of network elements,

wherein the at least one node is configured to support at least one communication mode selected from a group consisting of wireless communications, wired communications, and hybrid wired and wireless communications, and

wherein at least one redundant communication pathway is established among the plurality of network elements.

Claim 19. (Canceled)

Claim 20. (Previously presented) The sensor node of claim 56,
wherein the plurality of network elements comprises at least one network,
wherein the at least one network includes a network selected from the group consisting of
a wired network, a wireless network, and a hybrid wired and wireless network, and
wherein the at least one network comprises at least one network selected from a group
consisting of the Internet, a local area network, a wide area network, a metropolitan area network,
and an information service station.

Claim 21. (Previously presented) The sensor node of claim 56,
wherein the internetworking comprises providing remote accessibility using World
Wide Web-based tools to data, code, management, and security functions,
wherein the data includes signals and images,
wherein the code includes signal processing, decision support, and database
elements, and
wherein the management includes operation of the plurality of network elements.

Claim 22. (Previously presented) The sensor node of claim 56,
wherein the plurality of network elements comprises a plurality of network element sets
that are layered.

Claim 23. (Currently amended) The sensor node of claim 56,

wherein the plurality of network elements comprises a sensor network including at least one node,

~~wherein the at least one node comprises a plurality of node types,~~

wherein the at least one node ~~plurality of node types~~ includes at least one node of a first type and at least one node of a second type,

wherein a first network having a first node density is assembled using the at least one node of a first type,

wherein a second network having a second node density is assembled using the at least one node of a second type, and

wherein the second network is overlayed onto the first network.

Claim 24. (Previously presented) The sensor node of claim 56,
wherein the plurality of network elements comprises a sensor network,
wherein code and data anticipated for future use are predistributed through the sensor network using low priority messages, and
wherein the code and the data are downloadable from at least one location selected from a group consisting of storage devices of the plurality of network elements, and storage devices outside the sensor network.

Claims 25-26. (Canceled)

Claim 27. (Previously presented) The sensor node of claim 56,
wherein data processing is controlled using at least one processing hierarchy, and

wherein the at least one processing hierarchy controls at least one event selected from a group consisting of data classifications, data transfers, data queuing, data combining, processing locations, and communications among the plurality of network elements.

Claim 28. (Previously presented) The sensor node of claim 56,
wherein data is transferred using message packets,
wherein the message packets are aggregated into compact forms in the plurality of network elements using message aggregation protocols, and
wherein the message aggregation protocols are adaptive to data type, node density, message priority, and available energy.

Claim 29. (Previously presented) The sensor node of claim 56,
wherein the plurality of network elements comprises a sensor network including at least one node, and
wherein the functions of the at least one node include data acquisition, data processing, communication, data routing, data security, programming, and node operation.

Claim 30. (Currently amended) The sensor node of claim 56,
wherein the plurality of network elements comprises a sensor network including at least one node,
wherein the at least one node includes an application programming interface (API), at
~~least one processor coupled to a plurality of application programming interfaces (APIs),~~

~~wherein the sensor node is coupled to the plurality of APIs to allow control of the sensor node via the plurality of APIs,~~

wherein the API is plurality of APIs are configured to support remote reprogramming and control of at least one device selected from the group consisting of sensors, actuators, communications devices, signal processors, information storage devices, node controllers, and power supply devices, ~~and~~

~~wherein the plurality of APIs are layered.~~

Claim 31. (Previously presented) The sensor node of claim 30,
wherein the plurality of APIs are configured to enable distributed resource management by providing network resource information and message priority information to the plurality of network elements, and

wherein information transfer among the plurality of network elements is controlled using a synchronism hierarchy established in response to the resource information and message priority information.

Claim 32. (Previously presented) The sensor node of claim 56,
wherein the plurality of network elements comprises a sensor network including at least one node, and

wherein the at least one node is configured to control data processing and data transmission in response to a probability of a detected event.

Claim 33. (Previously presented) The sensor node of claim 56,

wherein the plurality of network elements comprises a sensor network including at least one node,

wherein the plurality of network elements are configured to self-assemble,

wherein search and acquisition modes of the at least one node are configured to search for participating ones of the plurality of network elements,

wherein a determination is made whether each of the participating ones of the plurality of network elements are permitted to join the sensor network using a message hierarchy, and

wherein the sensor network is surveyed at random intervals for new nodes and missing nodes.

Claim 34. (Previously presented) The sensor node of claim 56,

wherein the plurality of network elements comprises a sensor network including at least one node,

wherein the plurality of network elements further includes at least one database, wherein the at least one database includes at least one storage device selected from a group consisting of storage devices coupled to at least one of the plurality of network elements and storage devices of the at least one node, and

wherein the at least one database comprises data-driven alerting methods that recognize conditions on user-defined data relationships including coincidence in signal arrival, node power status, and network communication status.

Claim 35. (Previously presented) The sensor node of claim 56,

wherein the plurality of network elements comprises a sensor network including at least one node,

wherein data is collected from the sensor node by the at least one node,

wherein at least one operation is performed on the data in response to parameters established by a user,

wherein the at least one operation is selected from a group consisting of energy detection, routing, processing, storing, and fusing, and

wherein the routing, processing, storing, and fusing are performed in response to at least one result of the energy detection.

Claim 36. (Previously presented) The sensor node of claim 35,

wherein the routing comprises selecting at least one data type for routing, selecting at least one of the plurality of network elements to which to route the selected data, selecting at least one route to the selected at least one of the plurality of network elements, and routing the selected at least one data type to the selected at least one of the plurality of network elements.

Claim 37. (Previously presented) The sensor node of claim 35,

wherein the processing comprises selecting at least one data type for processing, selecting at least one processing type, selecting at least one of the plurality of network elements to perform the selected at least one processing type, and transferring the selected at least one data type to the selected at least one of the plurality of network elements using at least one route through the sensor network, and

wherein the selection of at least one processing type comprises determining at least one probability associated with a detected event and selecting at least one processing type in response to the at least one probability.

Claim 38. (Previously presented)

The sensor node of claim 35,

wherein the storing comprises selecting at least one data type for storage, selecting at least one storage type, selecting at least one of the plurality of network elements to perform the selected at least one storage type, and transferring the selected at least one data type to the selected at least one of the plurality of network elements using at least one route through the sensor network.

Claim 39. (Canceled)

Claim 40. (Previously presented)

The sensor node of claim 56,

wherein at least one of the plurality of network elements is configured to determine a position of the sensor node.

Claim 41. (Previously presented)

The sensor node of claim 56,

wherein the sensor node is configured to determine at least one position using location information received from at least one of the plurality of network elements.

Claim 42. (Canceled)

Claim 43. (Previously presented) The sensor node of claim 1,
wherein the at least one substrate comprises a thin film tape, and
wherein the thin film tape includes an adhesive.

Claim 44. (Canceled)

Claim 45. (Previously presented) The sensor node of claim 1, wherein the at
least one substrate is configured to operate as an acoustic sensor and source.

Claim 46. (Previously presented) The sensor node of claim 1, wherein the
at least one substrate comprises a material suitable for unrolling as a sensor tape to different
lengths.

Claim 47. (Previously presented) The sensor node of claim 1, wherein the at
least one energy source is a photovoltaic device incorporated in or mounted on the at least
one substrate.

Claim 48. (Previously presented) The sensor node of claim 1, wherein the
at least one substrate is configured to operate as a vibration and acoustic sensor.

Claim 49. (Previously presented) The sensor node of claim 1,
wherein the at least one substrate is configured to operate as an accelerometer; and
wherein the at least one energy source comprises one or more battery cells that are

configured to serve as proof masses for the accelerometer.

Claim 50. (Previously presented) A sensor node comprising:
a flexible substrate configured to operate as an acoustic sensor and an acoustic source;
a processor incorporated in or mounted on the flexible substrate, wherein the processor is configured to automatically join another node to form a network; and
an antenna incorporated in or carried on the flexible substrate and electrically coupled to the processor for wireless communication with the other node,
wherein the acoustic sensor is configured to determine a position of the sensor node,
wherein the sensor node is configured to communicate information identifying the determined position of the sensor node to the other node,
wherein the sensor node is configured to synchronize with the other node via radio frequency communications, and
wherein synchronization of the sensor node and the other node allows the sensor node to compensate for wind when determining a range of the sensor node.

Claim 51. (Previously presented) The sensor node of claim 50, wherein the flexible substrate is configured to operate as a sensor in an accelerometer.

Claim 52. (Previously presented) The sensor node of claim 50,
further comprising a photovoltaic device incorporated in or mounted on the flexible substrate,
wherein the photovoltaic device is electrically coupled to provide an energy source for

operation of the processor.

Claim 53. (Previously presented) The sensor node of claim 50, wherein the flexible substrate has an aerodynamic shape suitable for deployment by air.

Claims 54-55. (Cancelled)

Claim 56. (Previously presented) The sensor node of claim 1, wherein functions of the sensor node are remotely controllable and the sensor node is programmable via wireless internetworking among a plurality of network elements.

Claim 57. (Previously presented) The sensor node of claim 50, wherein the formed network includes a gateway node that links to another network, and wherein the other network comprises the Internet.

Claim 58. (Previously presented) The sensor node of claim 50, wherein the formed network includes a gateway node that is linkable to another network, wherein the other network comprises a client device, and wherein the sensor node is programmable by the client device.

Claim 59. (Currently amended) The sensor node of claim 50, wherein the ~~formed network~~ is operable to detect a second sensor node, wherein the second sensor node that is attached to a person or to a vehicle.

Claim 60. (Previously presented) The sensor node of claim 50,
wherein the flexible substrate comprises a flexible support material and a layer of
polyvinylidenedifluoride that is applied to the flexible support material, and
wherein the layer of polyvinylidenedifluoride is operable as the acoustic sensor and an
acoustic source.

Claims 61-62.(Cancelled)

Claim 63. (New) The sensor node of claim 1, wherein the at least one
sensor comprises at least one bi-static sensor.

Claim 64. (New) The sensor node of claim 1,
wherein when the modem operates in the slave mode, the sensor node is operable to
join two clusters of nodes, and
wherein each of the two clusters of nodes comprises a respective neighbor node that
operates as a master to the sensor node.

Claim 65. (New) The sensor node of claim 1,
wherein the sensor node is coupled to a package, and
wherein the at least one sensor is operable to sense opening and closing of the package.